



ASSOCIATION BETWEEN THE ABO BLOOD GROUP AND COVID-19 SUSCEPTIBILITY IN INDIAN POPULATION: A RETROSPECTIVE ANALYSIS

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Abstract:

Background: COVID-19 was declared a global crisis by the WHO. Recent studies have reported variable susceptibility to COVID-19 infections based on blood group. There is a paucity of data on the Indian population regarding the relationship between COVID-19 positivity and blood grouping. The objective was to determine the association between blood groups and the prevalence of COVID-19 positivity.

Methodology: Data was reviewed on all patients who presented to Gurukrupa Hospital, Amravati from March 2020 to June 2021. A total of 772 subjects, between the age groups of 18-91 years were included in the study. COVID-19 positivity, ABO, and Rh typing were determined based on their health records in the institute. The association between COVID-19 positivity and blood group was studied using Chi-square test. The association between COVID-19 positivity and comorbidities such as diabetes and hypertension was evaluated using Chi-square test.

Result: In total, 772 patients were included, with the majority being male patients at 61.40%. Among, 772 patients, 150 patients (19.43 %) had diabetes mellitus, as well as 313 patients (40.54%) were found to have hypertension. Based on the analysis, A+, B+, and O+ blood groups showed a higher number of COVID-19 positive results. The incidence of COVID-19 positivity among individuals with hypertension was found to be 48.36%, whereas among those with Diabetes Mellitus, it was 22.64%.

Conclusion: The association between blood groups and COVID-19 infection is complex with multiple factors such as comorbidities, age, sex, and the distribution of blood groups in the population. The prevalence of COVID-19 is greater in hypertensive subjects.

Keywords: Covid-19, susceptibility, ABO blood group

Introduction:

COVID-19 has resulted in significant morbidity and mortality, overwhelming healthcare systems worldwide. Risk factors such as age, gender,¹ preexisting comorbidities,² healthcare workers, and elevated pro-inflammatory cytokines² have been implicated in the development of COVID-19. A few recent studies have linked ABO blood groups with COVID-19.^{3,4} ABO blood group system has been associated with numerous viral infections like Rotavirus, Noroviruses, Dengue virus, Norwalk virus and Hepatitis B virus⁴ which emphasizes on the importance of this association in predicting susceptibility to viral illnesses. Several studies have been done in the past with diverse results. Studies from China have shown that individuals with blood group O have lower susceptibility, while a few others have reported no association.⁵ Frequencies of ABO phenotypes are highly variable between populations or geographical areas.⁶ We conducted the study to determine ABO blood group association with the COVID 19 positivity in the population of central India.

Material and Methodology:

This was an observational retrospective analysis of the medical records of 772 patients aged 18–91 years who presented to the out-patient department of Gurukrupa Hospital, Amravati from March 2020 to June 2021. COVID-19 positivity, ABO, and Rh typing were determined based on their medical records. The patients were categorized into COVID-19 positive and negative groups. Each group was further stratified into ABO and Rh blood groups. The distribution of blood groups in COVID-19-positive subjects was compared with COVID-19-negative subjects. The statistical program BM SPSS Statistics for Windows, version 22.0 (IBM Corp., Armonk, NY, USA) was used. Descriptive statistics were expressed using frequencies and percentages for quantitative and categorical variables. The association between COVID-19 positivity and blood group was studied using the Chi-square test. The prevalence of diabetes and hypertension was determined in COVID-19-positive and negative patients and compared using the Chi-square test. The study was approved by an institutional committee.

Statistical analysis-

The statistical program BM SPSS Statistics for Windows, version 22.0 (IBM Corp., Armonk, NY, USA) was used. Descriptive statistics relied on median and IQR for quantitative variables and on frequencies and percentages (%) for qualitative variables. Categorical variables are expressed as Number of patient’s and percentage of patients and chi square test was used to test the significance of categorical variables and $p < 0.05$ is considered as level of significance.

Observation and Result:

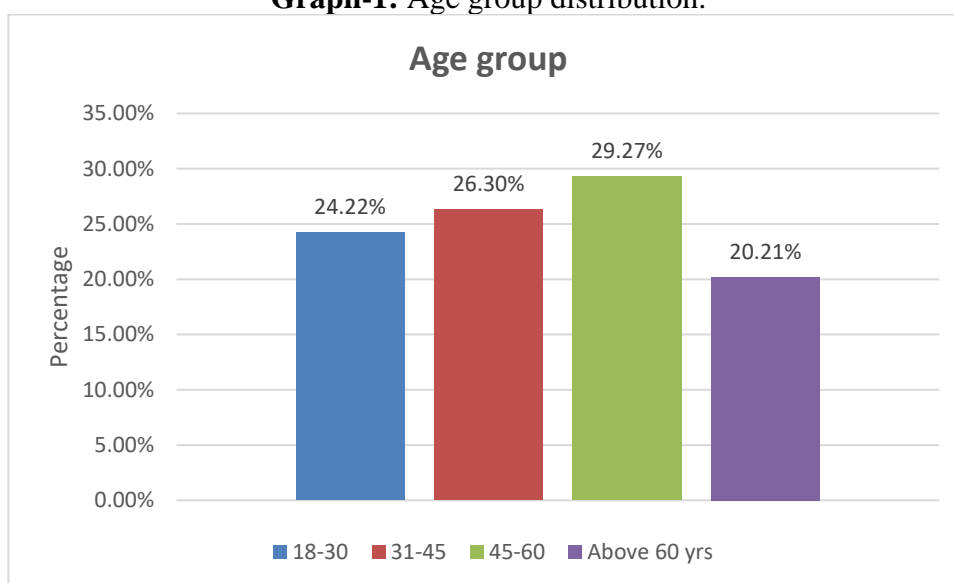
Table-1: Gender distribution.

Gender	No. of patients	Percentage
Male	474	61.40%
Female	298	38.60%
Total	772	100.00%
Blood group		
A-	9	1.17%
A+	137	17.75%
AB-	10	1.30%
AB+	49	6.35%
B-	9	1.17%
B+	268	34.72%
O-	9	1.17%
O+	281	36.40%
Total	772	100.00%

The gender distribution of patients, indicating that there were more male patients than female patients, with males comprising approximately 61.40% and females approximately 38.60% of the total patient population.

The table presents data on the distribution of patients based on their blood groups. Among the 772 patients considered, the most prevalent blood group is O+ with 281 cases (36.40%), followed closely by B+ with 268 cases (34.72%). A+ has 137 cases (17.75%), while AB+ accounts for 49 cases (6.35%). A-, AB-, B- as well as O- blood groups each have 9 or 10 cases, ranging from 1.17% to 1.30% of the total. This data provides insights into the distribution of blood groups among the patient population.

Graph-1: Age group distribution.



The data shows that the age group of 45-60 years has the maximum number of cases (226 cases, 29.27%), followed by the 31-45 age group (203 cases, 26.30%). The 18-30 age group has the lowest number of cases (187 cases, 24.22%), but still represents a significant proportion. The above 60 age group falls in the middle range with 156 cases (20.21%). This information provides valuable insights into the distribution of cases across different age groups.

Table-2: Contact with COVID person

Contact with COVID Person	No. of patients	Percentage
No	588	76.17%
Yes	184	23.83%
Total	772	100.00%

Out of the 772 patients under consideration, 588 (76.17%) have not been in contact with someone diagnosed with COVID-19. The remaining 184 (23.83%) have confirmed that they have had contact with a person who has been infected with the COVID-19 virus.

Table-3: Diabetic Mellitus and hypertension in COVID symptomatic patients.

Diabetic Mellitus	No. of patients	Percentage
No	622	80.56%
Yes	150	19.43%
Total	772	100.00%
Hypertension	No. of patients	Percentage
No	459	59.45%
Yes	313	40.54%
Total	772	100.00%

Out of 772 patients, 150 (19.43%) had diabetes mellitus, while 622 (80.57%) did not have diabetes mellitus. This means that about 1 in 5 patients in this population had diabetes mellitus. Additionally, 313 (40.54%) had hypertension, while 459 (59.46%) did not have hypertension. This means that about 1 in 2 patients in this population had hypertension.

Table-4: Fever in patients

Fever	No. of patients	Percentage
Present	260	33.68%
Absent	512	66.32%
Total	772	100.00%

Among the total of 772 patients, 260 individuals (approximately 33.68%) exhibited symptoms of fever, whereas 512 individuals (approximately 66.32%) did not manifest any fever-related symptoms. In essence, slightly more than a third of the patient population experienced fever, while slightly more than two-thirds remained without fever.

Table-5: No. of doses given.

Dose (Single/ Double)	No. of patients	Percentage
Double	44	5.70%
Single	73	62.39%
Total	117	7.25%

The data presented examines the administration of doses, specifically categorized as single or double. Among the total of 117 patients analyzed, 44 patients (5.70%) have received double doses, signifying that they have been given two doses of the treatment or vaccine. In contrast, 73 patients (9.46%) have only received a single dose. It is important to note that these 117 patients account for 15.16% of the overall population being considered.

Table-6: COVID report of patients.

COVID Report	No. of patients	Percentage
Negative	478	61.92%
Positive	294	38.08%
Total	772	100.00%

The data presented focuses on the COVID report status of patients. Among the 772 patients included, the majority of 478 patients (61.92%) have tested negative for COVID. Conversely, 294 patients (38.08%) have tested positive for COVID.

Table-7: Association between COVID reports with Gender.

COVID report	Female	Male	Odds Ratio	p value
Negative	189 (39.53%)	289 (60.47%)	1.11	0.49 [NS]
Positive	109 (37.07%)	185 (62.93%)		
Total	298 (100%)	474 (100%)		

The data presented focuses on the distribution of COVID report results based on gender. In the category of "Negative" COVID reports, there were 189 females and 289 males. The "Odds Ratio" of 1.11 suggests that females have a slightly higher odds of testing positive for COVID-19 compared to males. The calculated p-value of 0.49 shows that there is no statistically significant difference in the distribution of negative reports between females and males.

Table-8: Association between COVID reports with blood group.

Blood group	COVID report		
	Negative	Positive	Total
A-	4	5	9
A+	86	51	137
AB-	6	4	10
AB+	34	15	49
B-	7	2	9
B+	168	100	268
O-	5	4	9
O+	168	113	281
Total	478	294	772
P value	0.41 [NS]		

The data displays the number of COVID report cases for each blood group. Among negative reports, blood group A+ , B+ and O+ have the highest counts (86, 168 and 168 cases, respectively). The calculated p-value of 0.41 suggests no significant difference in COVID report distribution across blood groups among the 772 individuals analyzed.

Table-9: Association between COVID reports with hypertension.

Hypertension	COVID report		Total	Odds Ratio	P value
	Negative	Positive			
No	364	95	459	1.70	0.001 [S]
Yes	200	89	289		
Total	564	184	748		
Diabetic Mellitus					
No	382	222	454	1.55	0.02 [S]
Yes	72	65	287		

There were 478 patients with hypertension, of which 309 (65.0%) had a negative COVID-19 test result and 169 (35.0%) had a positive COVID-19 test result. The P value for the association between hypertension as well as COVID-19 was 0.001, which is statistically significant ($p < 0.05$). This means that there is a strong association among hypertension and COVID-19. The odds ratio for hypertension is 1.70. This means that people with hypertension are 70% more likely to test positive for COVID-19 than people without hypertension. There were 150 patients with diabetes mellitus, of which 229 (152.6%) had a negative COVID-19 test result and 65 (47.4%) had a positive COVID-19 test result. The P value for the association between diabetes mellitus and COVID-19 was 0.14, which is not statistically significant ($p > 0.05$). The odds ratio for diabetes mellitus is 1.55. This means that people with diabetes mellitus are 55% more likely to test positive for COVID-19 than people without diabetes mellitus.

Table-10: Association between comorbidities and type of blood group.

Blood Group	Comorbidities			P value
	Yes	No	Total	
A-	3 (33.33%)	6 (66.67%)	9	0.92 [NS]
A+	41 (29.93%)	96 (70.07%)	137	
AB-	4 (40%)	6 (60%)	10	
AB+	14 (28.57%)	35 (50.72%)	49	
B-	4 (44.44%)	5 (55.56%)	9	
B+	92 (34.32%)	176 (65.67%)	268	
O-	2 (22.22%)	7 (77.78%)	9	
O+	90 (30.03%)	191 (67.97%)	281	
Total	250 (32.38%)	522 (67.61%)	772	

In the A- blood group, 3 out of 9 individuals (33.33%) have comorbidities, while 6 do not. The P-value of 0.92 indicates that this difference is not statistically significant. The A+ and B+ blood groups have larger sample sizes, with 137 and 268 individuals, respectively. In these groups, 29.93% and 34.32% of individuals have comorbidities, respectively. The majority of individuals in these groups do not have comorbidities, with rates of 70.07% and 65.67%, respectively.

The O- blood group has the smallest sample size, with 9 individuals. In this group, 44.44% of individuals have comorbidities. This is higher than the percentages in the A-, A+, and B+ blood groups, but the difference is not statistically significant.

Table – 11: Comorbidities in COVID symptomatic patients

Comorbidities	No. of cases	Percentage
Diabetic mellitus	150	19.43%
Hypertension	313	40.54%
Both	281	36.40%
Total	772	100.00%

It is observed that 150 individuals within the sample have received a diagnosis of Diabetic Mellitus. This group constitutes roughly 19.43% of the entire sample. Secondly, within the "Hypertension" category, there are 313 individuals who have been identified as having Hypertension. This group comprises about 40.54% of the total sample, demonstrating a relatively higher prevalence of hypertension in comparison to Diabetic Mellitus within this population.

Lastly, the "Both" category accounts for individuals who have received diagnoses for both Diabetic Mellitus and Hypertension. Within this category, 281 individuals have been identified, making up approximately 36.40% of the total sample. This indicates a significant overlap between these two health conditions within the same individuals.

Discussion:

COVID-19 is a major health concern across the world. COVID-19 has been extensively studied in terms of risk factors, infectivity, pathogenesis and management. Among the COVID-19-positive cases, male preponderance was seen with M: F ratio of 3:2. It is known that male gender is a risk factor for COVID-19.¹

Blood group is another such risk factor that has resurfaced after several studies. ABO antigens are oligosaccharides present on red blood cells. Blood group antigens have become a primary focus of epidemiological studies due to their polymorphic nature and inheritance patterns across different populations.⁷ In Indian population, blood group B is most prevalent.⁷ Similarly, in the present study blood group A+, B+, AB+, O+ was the commonest that are 86, 168 and 168 cases, respectively.

There have been many studies that negate the association between COVID-19 infection and blood groups.⁸ The heterogeneity has been attributed to control, variation in phenotypes. The outcomes, infection or not, is largely dependent upon the variation in ABO phenotypes frequencies.⁶ For example, O blood group individuals if protected from transmission from non-O individuals, cannot be protected from transmission by other O blood group individuals. Consequently, the frequency of the O blood type in a population will be critical.⁶ An analysis was conducted to determine how the distribution of blood groups affects COVID-19 susceptibility and it was found that the population having a low frequency of blood group O, the individuals having blood group O had the benefit of protection from COVID-19 infection.⁶ Various studies suggest that anti-ABO antibodies play a prominent role in protection against infection but that their impact is heavily influenced by the relative frequencies of ABO phenotypes in the population.⁶

An association was found between Rh positivity and COVID-19 positivity indicating that COVID-19 infection is common among Rh-positive individuals. This is congruent with a study where Rh negativity was demonstrated as a protective factor for COVID-19 infection.⁹

The comorbidities that our study subjects had included hypertension and type 2 diabetes mellitus. 313 (40.54%) cases were hypertensive. We found an association between hypertension and COVID-19 infectivity (p-value 0.001). There is evidence to support that the incidence of COVID-19 is higher in patients with hypertension.¹⁰ Studies have shown that ACE2 expression at the cell surface is enhanced in patients treated with ACE inhibitors and angiotensin receptor blockers making the subjects susceptible to infection by providing a greater number of attachments for COVID-19. This finding has an implication in the management of hypertension in areas with high transmission rates.

150 (19.43%) subjects had diabetes mellitus. Several studies have shown that the prevalence of diabetes mellitus ranges from 10-35%.¹¹ A change in the immune profile from regulatory T-cells to proinflammatory Th1 and Th17 CD4⁺ T cells makes diabetes mellitus patients more susceptible to infections.¹² However, our study failed to establish an association between DM and incidence of COVID-19.

A major limitation of our study was that data from other centers was not gathered. The sample size was small. Confounding factors such as age, diabetes, and hypertension were not considered while studying the association of COVID-19 with blood groups.

Conclusion:

The association between blood groups and COVID-19 infection is complex with multiple factors such as comorbidities, age, sex, and the distribution of blood groups in the population. The prevalence of COVID-19 is greater in hypertensive subjects.

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